Application No. 10/764,615

IN THE CLAIMS:

1. – 4. (canceled)

5. (currently amended) ~~The apparatus of Claim 1 wherein one of said plurality of sensor modules is attached to a linear variable differential transformer, said step of calibrating said one of said plurality of sensor modules including the steps of:~~An apparatus for monitoring a production process performed by a production machine, said apparatus comprising:

a plurality of sensor modules, each of said plurality of sensor module accepting an input from a sensor selected from the group consisting of a linear variable differential transformer, a slide encoder, a current loop, a dc voltage sensor, a differential voltage sensor, a piezoelectric vibration sensor, and a power sensor, each of said plurality of sensor modules including a signal conditioning circuit for conditioning said input;

a plurality of module slots each adapted to receive one of said plurality of sensor modules;

a processing device performing a method of monitoring a production process, said method comprising the steps of:

(a) identifying the sensor module installed in each of said plurality of module slots;

(b) calibrating the sensor module installed in each of said plurality of module slots;

(c) acquiring a stream of data from the sensor module installed in selected ones of said plurality of module slots;

(d) processing the stream of data;

(e) generating a visual presentation for the stream of data;

(f) accepting scale information for the linear variable differential transformer input;

(g) setting a gain to an initial value;

(h) setting an offset to an initial value;

(i) recording a minimum voltage produced as a complete range of movement of the linear variable differential transformer is traversed;

PAGE 5/19 * RCVD AT 12/30/2005 4:13:01 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/24 * DNIS:2738300 * CSID:8655234478 * DURATION (mm-ss):04-40

(j) recording a maximum voltage produced as the complete range of movement of the linear variable differential transformer is traversed;

(k) identifying a linear region of operation of the linear variable differential transformer;

(l) adjusting said offset while the linear variable differential transformer is operating within the linear region; and

(m) adjusting said gain while the linear variable differential transformer is operating at a maximum desirable position within the complete range of movement;

an interface circuit in communication between said plurality of module slots and said processing device, said interface circuit converting analog signals into digital signals and digital signals into analog signals;

a display device in communication with said processing device, said display device displaying said visual presentation in a human readable format;

a gain control circuit in communication responsive to said processing device and in communication with said signal conditioning circuit in each of said plurality of sensor modules, said gain control circuit amplifying the stream of data from the sensor module installed in selected ones of said plurality of module slots;

an offset control circuit in communication responsive to said processing device and in communication with said signal conditioning circuit in each of said plurality of sensor modules, said offset control circuit applying a dc voltage offset to the stream of data from the sensor module installed in selected ones of said plurality of module slots;

a latch control circuit in communication responsive to said processing device and in communication with said signal conditioning circuit in each of said plurality of sensor modules, said latch control circuit holding values of the stream of data from the sensor module installed in selected ones of said plurality of module slots;

an input device in communication with said processing device, said input device accepting commands from a user thereby allowing the user to control said processing device; and

a storage device in communication with said processing device, said storage device for storing said data for later recall.

6. (currently amended) An apparatus for monitoring a production process performed by a production machine, said apparatus comprising:

a plurality of module slots~~, each of said plurality of module slots adapted to~~ for receiving~~e~~ a~~-~~sensor modules of various types;

a processing device performing a method of monitoring ~~a~~ the production process, said method comprising the steps of:

(a) identifying the type of sensor module installed in each of said plurality of module slots;

(b) calibrating the sensor module installed in each of said plurality of module slots;

(c) acquiring a stream of data from the sensor module installed in selected ones of said plurality of module slots;

(d) processing the stream of data;

(e) generating a visual presentation for the stream of data;

an interface circuit in communication between said plurality of module slots and said processing device, said interface ~~device~~ circuit converting analog signals into digital signals and digital signals into analog signals;

a display device in communication with said processing device, said display device displaying said visual presentation in a human readable format;

an input device in communication with said processing device, said input device accepting commands from a user to control said processing device.

7. (previously presented) The apparatus of Claim 6 further comprising a switching circuit in communication with said plurality of modules slots, said switching circuit adapted to split the input from one of said plurality of sensor modules into a first signal and a second signal, said switching circuit passing said second signal to another of said plurality of sensor modules, wherein said first signal and second signal are processed independently.

PAGE 7/19 * RCVD AT 12/30/2005 4:13:01 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/24 * DNIS:2738300 * CSID:8655234478 * DURATION (mm-ss):04-40

8. (currently amended) The apparatus of Claim 6 further comprising a plurality of sensor modules installed in said module slots, each of said plurality of sensor modules accepting an input from a sensor selected from the group consisting of a linear variable differential transformer, a slide encoder, a current loop, a dc voltage sensor, a differential voltage sensor, a piezoelectric vibration sensor, and a power sensor, each of said plurality of sensor modules including a signal conditioning circuit.

9. (previously presented) The apparatus of Claim 8 further comprising a gain control circuit in communication with said signal conditioning circuit of each said plurality of sensors modules and responsive to said processing device, said gain control circuit amplifying the stream of data from the sensor module installed in selected ones of said plurality of module slots.

10. (previously presented) The apparatus of Claim 8 wherein said signal conditioning electronics have a first calibration range associated with the sensor and a second calibration range associated with said sensor, said first calibration range being wider than said second calibration value, said first calibration value being used for data acquisition and said second calibration value being used for data display.

11. (previously presented) The apparatus of Claim 6 further comprising an offset control circuit in communication with said signal conditioning circuit of each said plurality of sensors modules and responsive to said processing device, said offset control circuit applying a dc voltage offset to the stream of data from the sensor module installed in selected ones of said plurality of module slots.

12. (previously presented) The apparatus of Claim 6 further comprising a latch control circuit in communication with said signal conditioning circuit of each said plurality of sensors modules and responsive to said processing device, said latch control circuit holding a value of the stream of data from the sensor module installed in selected ones of said plurality of module slots.

PAGE 8/19 * RCVD AT 12/30/2005 4:13:01 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/24 * DNIS:2738300 * CSID:8655234478 * DURATION (mm-ss):04-40

Application No. 10/764,615

13. (previously presented) The apparatus of Claim 6 further comprising an input device allowing user control of said process device.

14. (previously presented) The apparatus of Claim 6 further comprising a machine interface in communication with the processing device and a control circuit of the production machine having control over various process parameters, wherein said processing device accepts commands from said input device and generates control signals transmitted through said machine interface thereby allowing a user to adjust the various process parameters of the production machine.

15 – 16. (canceled)

17. (currently amended) A method of monitoring a production process, said method comprising the steps of:

(a) identifying sensor modules installed in a hardware monitoring device;

(b) calibrating the sensor modules installed in the hardware monitoring device;

(c) acquiring data from the sensor modules;

(d) processing the data acquired from the sensor modules;

(e) generating a visual presentation from the data acquired from the sensor modules; ~~The apparatus of Claim 16 wherein a linear variable differential transformer is being used as a sensor, said step of calibrating the sensor modules including the steps of:~~

(f) accepting scale information for a linear variable differential transformer input;

(g) setting a gain to an initial value;

(h) setting an offset to an initial value;

(i) recording a minimum voltage produced as a complete range of movement of the linear variable differential transformer is traversed;

(j) recording a maximum voltage produced as the complete range of movement of the linear variable differential transformer is traversed;

(k) identifying a linear region of operation of the linear variable differential transformer;

PAGE 9/19 * RCVD AT 12/30/2005 4:13:01 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/24 * DNIS:2738300 * CSID:8655234478 * DURATION (mm-ss):04-40

(l) adjusting said offset while the linear variable differential transformer is operating within the linear region; and

(m) adjusting said gain while the linear variable differential transformer is operating at a maximum ~~desirable~~ desired position within the complete range of movement.

18. (new) A method of monitoring a production process using a hardware monitoring device having at least one sensor module installed therein, the method comprising the steps of:

(a) acquiring sensor data using the at least one sensor module;

(b) splitting the sensor data from the at least one sensor module into a first signal and a second signal;

(c) processing the first and second signals independently; and

(d) generating a visual representation of the first and second signals substantially simultaneously on a display device.

19. (new) The method of claim 18 wherein

step (c) further comprises processing the first signal at a first amplitude scale and the second signal at a second amplitude scale that is different from the first amplitude scale; and

step (d) further comprises generating the visual representation of the first signal at the first amplitude scale and generating the visual representation of the second signal at the second amplitude scale.

20. (new) The method of claim 18 wherein

step (c) further comprises processing the first signal at a first time scale and the second signal at a second time scale that is different from the first time scale; and

step (d) further comprises generating the visual representation of the first signal at the first time scale and generating the visual representation of the second signal at the second time scale.

PAGE 10/19 * RCVD AT 12/30/2005 4:13:01 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/24 * DNIS:2738300 * CSID:8655234478 * DURATION (mm-ss):04-40

21. (new) The method of claim 18 further comprising calibrating the at least one sensor module at a first calibration range for the first signal and a second calibration range for the second signal, where the first calibration range is different from the second calibration range.

22. (new) The method of claim 18 further comprising:

(e) monitoring the sensor data to detect interruptions in acquisition of the sensor data ;

(f) generating an alert signal upon detection of an interruption in the acquisition of the sensor data; and

(g) pausing processing of the sensor data upon detection of an interruption in the acquisition of the sensor data.

23. (new) An apparatus for monitoring a production process performed by a production machine, said apparatus comprising:

at least one sensor module for generating sensor signals related to the production process;

a switching circuit in communication with the at least one sensor module, the switching circuit for splitting the sensor signals into a first signal and a second signal;

a processing device in communication with the switching circuit for receiving and processing the first and second signals independently;

a display device for generating a visual representation of the first and second signals; and

an input device in communication with the processing device, the input device for accepting commands from a user to control the processing device to selectively modify the visual representation of the first and second signals on the display device.

24. (new) The apparatus of claim 23 wherein

the processing device processes the first signal at a first amplitude scale and the second signal at a second amplitude scale that is different from the first amplitude scale, and

the display device generates the visual representation of the first signal at the first amplitude scale and generates the visual representation of the second signal at the second amplitude scale.

PAGE 11/19 * RCVD AT 12/30/2005 4:13:01 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/24 * DNIS:2738300 * CSID:8655234478 * DURATION (mm-ss):04-40

25. (new) The apparatus of claim 23 wherein

the processing device processes the first signal at a first time scale and the second signal at a second time scale that is different from the first time scale, and

the display device generates the visual representation of the first signal at the first time scale and generates the visual representation of the second signal at the second time scale.

26. (new) The apparatus of claim 23 wherein the display device generates a graphic overlay of the first and second signals.

27. (new) A method of monitoring a production process using a hardware monitoring apparatus having one or more sensors selected from the group consisting of a dc sensor, a differential sensor, a current sensor and a position sensor, the method comprising:

(a) entering scale information for the one or more of the sensors;

(b) setting a gain to an initial value for the one or more of the sensors;

(c) setting an offset to an initial value for the one or more of the sensors;

(d) recording a minimum voltage produced by the position sensor as a complete range of movement of the position sensor is traversed;

(e) recording a maximum voltage produced by the position sensor as the complete range of movement of the position sensor is traversed;

(f) identifying a linear region of operation of the position sensor;

(g) adjusting the offset while the position sensor is operating within the linear region; and

(h) adjusting the gain while the position sensor is operating at a maximum desired position within the complete range of movement.

28. (new) The method of claim 27 wherein step (a) further comprises:

(a1) entering the maximum linear travel of the position sensor in units of length; and

(a2) entering the maximum linear travel of the position sensor in units of voltage.

PAGE 12/19 * RCVD AT 12/30/2005 4:13:01 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/24 * DNIS:2738300 * CSID:8655234478 * DURATION (mm-ss):04-40

29. (new) The method of claim 27 wherein:

step (c) further comprises setting the offset to zero; and

step (b) further comprises setting the gain so that the maximum voltage produced by each of the sensors is substantially equivalent to a known reference value.

30. (new) The method of claim 27 wherein the position sensor is selected from the group consisting of a slide encoder and a linear variable differential transformer.

31. (new) A method of monitoring a production process using a hardware monitoring device having at least one sensor module installed therein, the method comprising the steps of:

(a) calibrating the at least one sensor module over a first amplitude range;

(b) acquiring sensor data using the at least one sensor module over the first amplitude range; and

(c) generating a visual representation of the sensor data on a display device, wherein the visual representation is over a second amplitude range that is less than or greater than the first amplitude range,

wherein steps (b) and (c) are performed substantially simultaneously.

32. (new) A method of monitoring a production process using a hardware monitoring device having at least one sensor module installed therein, the method comprising the steps of:

(a) acquiring sensor data using the at least one sensor module;

(b) generating a first visual representation of the sensor data on a display device, wherein the first visual representation has a first time scale;

(c) generating a second visual representation of the sensor data on the display device, wherein the second visual representation has a second time scale that is different from the first time scale; and

(d) switching from the first visual representation to the second visual representation on the display device while continuously performing step (a).

PAGE 13/19 * RCVD AT 12/30/2005 4:13:01 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/24 * DNIS:2738300 * CSID:8655234478 * DURATION (mm-ss):04-40

33. (new) A method of monitoring a production process using a hardware monitoring device having a plurality of sensor module slots for receiving a plurality of sensor modules, the method comprising the steps of:

(a) installing one or more of the sensor modules in corresponding ones of the sensor module slots;

(b) sensing a module identification voltage provided by one of the sensor modules;

(c) accessing a look-up table that associates the module identification voltage to a specific type of sensor module;

(d) determining the type of sensor module based at least in part on step (c); and

(e) repeating steps (b), (c) and (d) until the type of each of the sensor modules installed in step (a) is identified.

34. (new) The apparatus of claim 6 wherein:

the display device has a display range bounded by a maximum display amplitude and a minimum display amplitude;

the processing device further for applying an amplitude offset to the visual presentation to maintain the displayed stream of data between the maximum and minimum display amplitudes of the display device; and

the input device further for accepting a command from the user to prompt the processing device to apply the amplitude offset.

35. (new) The apparatus of claim 6 wherein:

the display device has a display range bounded by a maximum display amplitude and a minimum display amplitude;

the input device further for accepting input from the user to set a maximum value for the maximum display amplitude and a minimum value for the minimum display amplitude; and

PAGE 14/19 * RCVD AT 12/30/2005 4:13:01 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/24 * DNIS:2738300 * CSID:8655234478 * DURATION (mm-ss):04-40

the processing device further for automatically applying an amplitude offset to the visual presentation to continuously maintain the displayed stream of data between the maximum value and the minimum value.

PAGE 15/19 * RCVD AT 12/30/2005 4:13:01 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/24 * DNIS:2738300 * CSID:8655234478 * DURATION (mm-ss):04-40